Operating Experience Weekly Summary 97-43

October 17 through October 23, 1997

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EVENTS

1. NORMAL POWER LOSS TO CRITICALITY SYSTEM MAIN PANEL

On October 15, 1997, at Rocky Flats Environmental Technology Site, a 15-amp supply breaker tripped, causing a loss of normal power to a criticality safety alarm system main panel. Maintenance personnel could not reset the system breaker, so facility managers declared the criticality safety alarm system inoperable. The facility manager directed evacuation of the building, established incident command, secured the facility, and accounted for all personnel after the evacuation. The battery backup for the alarm system remained operational during the power loss. Investigators determined that non-essential loads connected to circuits on the emergency power distribution panel caused the breaker to trip. Failure to manage the system configuration resulted in the criticality system being declared inoperable, evacuation of the facility, and impacted facility operations. (ORPS Report RFO--KHLL-371OPS-1997-0090)

When maintenance personnel re-entered the building to troubleshoot the problem, they determined that the emergency power distribution panel supplying power to the criticality alarm system main panel was overloaded. They determined that non-essential loads, such as personal radios, coffee pots, and microwave ovens, were also being powered by the emergency power distribution panel. They removed all non-essential loads, marked the outlets out-of-service, and successfully reset the breaker.

This was the second loss of power to the main panel in two days. Maintenance personnel determined that shop and office electrical outlets were powered from the emergency power distribution panel, and some of them were not labeled as emergency power outlets. Because workers had plugged various electrical items into the outlets, the rated capacity of the transformer was exceeded, causing the supply breaker to trip. Figure 1-1 shows a simplified drawing of the criticality system main panel power supply.

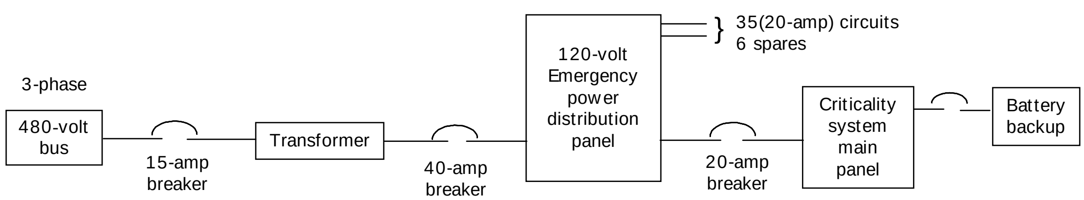


Figure 1-1. Simplified Drawing of the Criticality System Main Panel Power Supply

The facility manager held a fact-finding meeting. He directed Maintenance to ensure that no personal items are plugged into outlets fed from the emergency power distribution panel. He also told them to install caution tags on the outlets indicating “emergency use only.” The following corrective actions to prevent recurrence will be implemented.

- A work package to locate and uniquely identify all outlets powered from the emergency power distribution panel will be developed.
- All non-emergency loads will be disconnected from the distribution panel.

- Non-emergency power will be provided to the shop and office areas.

The facility manager also directed the following actions to ensure that the system functions properly and no similar conditions exist for other emergency power distribution panels.

- The power rating of the emergency power distribution panel supply transformer will be evaluated.

- The 15-amp supply breaker will be tested to ensure it does not trip below its setpoint.

- Other 120-volt emergency power distribution panels in the facility will be evaluated to ensure similar conditions do not exist.

NFS has reported criticality alarm system malfunctions in several Weekly Summaries. Following are some examples.

- Weekly Summary 97-03 reported that maintenance personnel at the Hanford site actuated a criticality safety alarm when they short-circuited the 24-volt dc wiring. The short circuit occurred while they were modifying the panels to correct problems associated with a battery backup system. Critique members determined that the engineer who performed a technical review of the criticality alarm panel replacement based his review on personal knowledge and focused only on the power supply wiring, not the signal wiring. Critique members also determined there were no additional review requirements for the work package beyond the cognizant engineer's review. (ORPS Report RL--PHMC-PFP-1997-0003)

- Weekly Summary 96-16 reported that a criticality alarm panel at the Hanford Plutonium Finishing Plant was de-energized, resulting in inoperable criticality alarm horns and indicating lights for two buildings. Loss of power to a battery charger resulted in the batteries discharging and loss of the criticality alarm function. An inadequate surveillance data sheet, a communications breakdown, and a potential design deficiency led to the loss of criticality horns and indicating lights in two buildings. (ORPS Report RL--WHC-PFP-1996-0018)

- Weekly Summary 95-25 reported that instrument specialists at Los Alamos National Laboratory determined that a criticality alarm system was incorrectly wired and would not function as designed in the event of a large criticality accident. While inspecting the criticality alarm system, they discovered that the current-mode output of the Geiger-Mueller detectors was not connected. The current-mode output ensures that high radiation fluxes (e.g., from a large or nearby criticality accident) that might saturate the detector are still detectable. Engineers performed a safety evaluation and determined that the as-found condition comprised an unreviewed safety question. (ORPS Report ALO-LA-LANL-TA55-1995-0027)

OEAF engineers searched the ORPS database for events involving criticality alarm malfunctions and found 286 occurrences. Figure 1-2 shows the root causes for these events. A review of these occurrences shows that DOE facility managers reported 38 percent of the root causes as equipment/material problems, with 80 percent attributed to defective or failed parts. In addition, 30 percent of the root causes were reported as management problems, with 32 percent attributed to inadequate administrative control and 26 percent attributed to work organization/planning deficiencies.

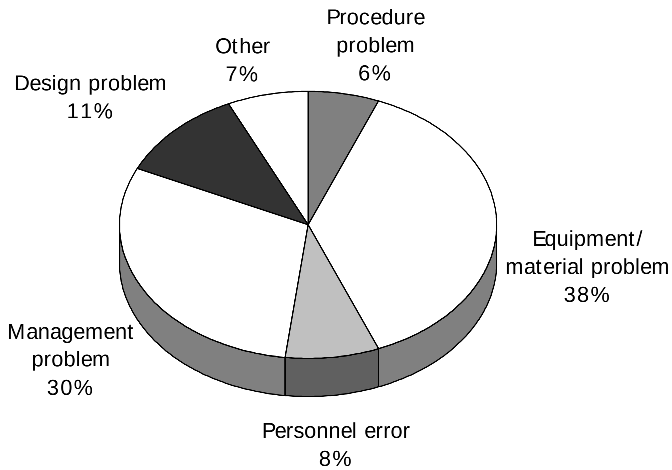


Figure 1-2. Root Causes for Criticality Alarm Malfunctions[1]

This event illustrates the consequences of inadequate configuration control. Lack of detailed knowledge about system configuration and routing of power circuits can result in failure to recognize if installations, modifications, maintenance activities, or even plugging in personal items will impact a system or an associated system. Electrical modifications have the potential to degrade or disable all or part of important safety-class systems. DOE facility managers should ensure that they have established a method for continuously monitoring the integrity of criticality alarm system lines and components to preclude failures. Criticality safety managers and engineers responsible for criticality safety systems should ensure that detection and alarm system requirements are documented and adhered to. Maintenance personnel should ensure that equipment and systems for criticality safety systems are properly maintained and labeled.

- DOE O 420.1, *Facility Safety,* provides direction for establishing nuclear criticality safety program requirements. The Order invokes several American Nuclear Society standards for design and operation of detecting systems, including ANS 8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,* and ANS 8.3, *Criticality Accident Alarm System,* which provides direction for establishing and maintaining an alarm system. Section 4.2, “Coverage,” provides guidance for determining the need for a criticality alarm system. Section 5.1, “Reliability,” states that systems shall be designed for high reliability and should be designed to minimize the effects of deterioration, power surges, and other adverse conditions.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, requires systematic identification and control of design and facility information that is important to management and operation. Chapter 18 of the Order discusses equipment and piping labeling.

[1] OEAF engineers searched the ORPS database using the graphical users interface for reports with all narrative containing “criticality alarm@” AND “degrad@ OR malfunction@ OR fail@ OR lost” and found 286 occurrences. Based on a random sampling of 25 events, OEAF engineers determined that each slice is accurate within ± 1.6 percent.

- DOE-STD-1073-93, *Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management,* provides guidance on retention of design analyses and design documentation to confirm configuration of systems and identify bases. The standard also states that physical configuration assessments or walk-downs should be performed for representative sample structures, systems, and components within the facility to determine the degree of agreement between the physical configuration and the configuration on the facility documentation. Physical walk-downs should be included as part of the programmatic assessments conducted during initial assessments, post-implementation assessments, and periodic effectiveness assessments. Appendix II-A of the standard states that critical load growths should be identified for tracking to ensure loads do not exceed design capacities or assumptions. Design verification checklists may be used to track cumulative effects for variable design features such as loads on batteries or emergency distribution power panels.

KEYWORDS: criticality alarm, electrical fault, breaker

FUNCTIONAL AREAS: Electrical Maintenance, Configuration Control, Design

2. OPERATOR TRANSFERS MATERIAL WITHOUT A PROCEDURE

On October 8, 1997, at the Savannah River Site, an operator used a portable sump pump and tygon tubing to transfer radioactive material from a tank into a sump without using a procedure, without establishing an airborne radioactivity area, and without using respiratory protection. Radiological control technicians determined that no air activity was detected on facility air sampling monitors during or after the evolution. However, internal dosimetry personnel placed the operator on a bioassay program as a precautionary measure. Operators must stop work and obtain additional guidance when procedural guidance ends. In addition, proper planning and authorization are required before operating systems outside the bounds of approved procedures because of the increased potential for abnormal system configurations that could affect facility operations and personnel safety. (ORPS Report SR--WSRC-FCAN-1997-0037)

The procedure normally used for this evolution delineated how to transfer the material from a tank to a sump using steam. However, the operator could not use steam because the facility was in a steam outage, so she used the portable sump pump and tygon tubing to transfer the material into the sump. Investigators determined that the operator needed to establish an airborne radioactivity area and use respiratory protection to perform this evolution.

The facility manager realized that the material transfer had not been controlled by a procedure during his review of daily activities. He held a critique and directed the following actions.

- Brief all operations personnel on the event.
- Issue a lessons-learned document.
- Revise procedures to include the use of a sump pump to transfer material.
- Take administrative actions, as necessary.

He also held a management review meeting to review operational administrative controls. All evolutions in the area are on hold until the review is completed.

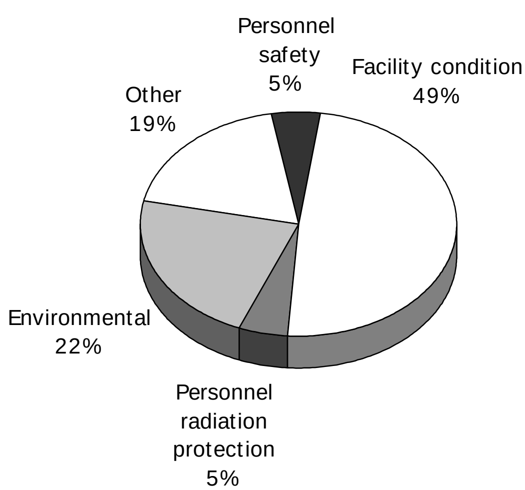
NFS has reported on work performed without a procedure in several Weekly Summaries. Following are some examples.

- Weekly Summary 97-14 reported that an inexperienced operator at the Mound Plant attempted to switch dryer towers while responding to a tritium alarm and released approximately 10 curies of tritium to the environment. The operator, who was still in training, responded to the tritium alarm because the other qualified operators were out of town. Formalized procedures for performing the evolution did not exist. (ORPS Report OH-MB-EGGM-EGGMAT01-1997-0007)

- Weekly Summary 96-47 reported that operators at the Savannah River Site transferred 240 gallons of water through a temporary line from one off-gas scrubber to another without a procedure, temporary modification, or authorization from the facility manager. Investigators learned that the supervisor believed the change did not require a temporary modification or procedure revision because the setup did not require installation of permanent equipment and the transfer was similar to equipment flushing operations. (ORPS Report SR--WSRC-RMAT-1996-0007)

- Weekly Summary 96-29 reported that a contractor engineer and an off-site vendor at Rocky Flats Environmental Technical Site adjusted a supply fan controller without a work control package or procedures and without the knowledge of building managers. The engineer and vendor attached a test box to the fan controller and removed the input for outside air temperature to test controller response. They did not change the setpoints, and they re-connected the air temperature connection only after facility supervisors stopped the work. (ORPS Report RFO--KHLL-SOLIDWST-1996-0095)

OEAF engineers searched the ORPS database for events with a root cause of lack of procedure and found 693 events, with 762 nature of occurrences. Figure 2-1 shows the nature of occurrences for these events. A review of these occurrences shows that 49 percent of the events affected the facility condition, with 22 percent attributed to vital system/component degradation. In addition, 22 percent of the events that affected the facility condition were reported as environmental, with 40 percent resulting in hazardous substance releases and an additional 21 percent involving radionuclide releases.



Facility Condition	Percent
Operations	28
Vital system/component degradation	22
Loss of control of radioactive material/spread contamination	16
Violation/inadequate procedures	16
Other	10
Safety status degradation	8

Figure 2-1. Nature of Occurrences for Lack of Procedure Events[1]

This event illustrates the need for operators to ensure that operations are discontinued when procedural guidance ends. Changing the configuration of systems or equipment without procedures could lead to personnel contamination, misalignment of components, or could violate the facility design basis. Performing hazard assessments will help identify where procedures are lacking or are deficient. OEAF recommends performing hazard assessments for all jobs. Hazard assessments are valuable for identifying inherent or potential hazards that may be encountered in the work environment, including procedural deficiencies. At a minimum, a hazard assessment should include four elements.

- Identify the operation or job to be assessed.
- Divide the job or operation into constituent tasks.
- Identify the hazards associated with each task.
- Determine the necessary hazard controls.

Successful evaluation and identification of hazards must be an on-going process and should be performed for the following job phases.

- initially, during the work planning phase
- immediately when the work process or job starts (This assessment should be a more detailed, "real time" evaluation and should be used to further define existing hazards and aid in the selection of appropriate engineering and administrative controls.)
- before any change in the job, task, or process
- as required by changing work conditions
- continually, as appropriate

Managers and supervisors in charge of job performance should ensure that hazards associated with infrequently performed tasks are identified and corrected. DOE facility managers should ensure that personnel understand the basics of work control practices and safety and health hazard analyses.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter XVI, "Operations Procedures," states that procedures provide direction to ensure that the facility is operated within its design basis. The Order also states that procedures should be effectively used to support safe operation of the facility. As stated in the Order, "procedures should be developed for all anticipated operations, evolutions . . . and . . . should provide administrative and technical direction to conduct the intent of the procedure effectively. Sequence of procedural steps should conform to the normal or expected operational sequence."

- DOE-STD-1039-93, *Guide to Good Practices for Control of Equipment and System Status*, states that special administrative controls are required when equipment is operated with temporary modifications (e.g., jumpers, blocks, bypasses). These controls should include methods to ensure that operators are aware of the modified equipment status and its operating limitations. Controls should include safety reviews, documentation, procedures and drawing updates, and training. A status control program should specify methods for verifying and documenting equipment

[1] OEAF engineers searched the ORPS database using the graphical users interface for reports with a root cause code "2B" (lack of procedure) and found 693 events, with 762 nature of occurrences. Based on a random sampling of 25 events, OEAF engineers determined that each slice is accurate within ± 1 percent.

and system configuration, changes in equipment status, and compliance with operational and safety limits. Criterion 7 states that for equipment important to safety, all activities that affect operations should be properly analyzed, documented, and authorized.

KEYWORDS: operating procedures, configuration management

FUNCTIONAL AREAS: Procedures, Operations, Hazard Analysis

3. VACUUM PUMPS WITH TRITIUM CONTAMINATION SHIPPED OFF-SITE

On October 8, 1997, at Los Alamos National Laboratory, the facility manager for the Accelerator Complex reported that shippers sent seven vacuum pumps to an off-site company for maintenance and three of the pumps were internally contaminated. The three pumps contained residual oil contaminated with up to 6 µCi per liter of tritium, which is equivalent to 13 million dpm. The off-site company did not know the pumps were contaminated and did not have the controls, procedures, and radiological support to work on contaminated equipment. Radiological control technicians surveyed the seven vacuum pumps for oil contamination and surface contamination before shipment. After the survey, they stored the pumps in a controlled area but did not tag them to indicate the presence of internal contamination. Investigators determined that shippers removed the pumps from the controlled area and shipped them off-site without proper controls and labeling. A team of Los Alamos and DOE evaluators visited the off-site maintenance facility and took smear samples that indicated there was no spread of contamination to the employees, their tools, or the workplace. This event is significant because it resulted in a loss of control of radioactive material and could have caused a spread of contamination. (ORPS Report ALO-LA-LANL-ACCCOMPLEX-1997-0014)

On June 18, 1997, survey results of oil samples drained from the pumps indicated that three of the seven pumps were contaminated. Shippers sent the pumps off-site for maintenance on July 17. The company serviced and returned two of the contaminated pumps to Los Alamos, but they did not return the third pump (with the highest level of contamination). Investigators determined that when radiological control personnel contacted the organization responsible for the pumps to find out what they should do with the contaminated oil samples, the organization decided to check on the status of the pumps. They learned the pumps had been shipped for maintenance. The facility manager notified the off-site company of the contaminated pumps on October 8. An investigation of the incident to determine root cause continues.

OEAF engineers reviewed a final report on an event at Los Alamos where a technician removed an internally contaminated vacuum pump from a storage area without release surveys. The pump was tagged as “Possible Internal Contamination” and contained 11,600 dpm beta/gamma, removable contamination. Procedures required radiological control personnel to survey equipment before releasing it. Investigators determined that the direct cause was personnel error (procedure not used or used incorrectly) and the root cause was a management problem (policy not defined, disseminated, or enforced). (ORPS Report ALO-LA-LANL-ACCCOMPLEX-1996-0009)

Another event involving the shipment of contaminated equipment to a facility that was not equipped to perform contaminated work occurred on April 17, 1997, at the Savannah River Site. Site Utilities Division personnel shipped an internally contaminated 300-hp cooling tower motor to an on-site motor shop that could not work on contaminated equipment. When shop personnel notified Site Utilities Division personnel that the motor was tagged “Fixed Internal Contamination,” they were told that the tag should have been removed. Shop personnel requested that health physics technicians perform a courtesy contamination scan. The scan showed that the internal windings of the motor had 30,000 dpm fixed beta/gamma contamination. Shop personnel placed the motor in an isolated area of the shop, and health physics technicians roped off the area. (ORPS Report SR--WSRC-CSWE-1997-0007)

These events illustrate an informal attitude toward control of radioactive material and shipping. Each of them resulted in an evolution that could have caused radiation exposures to workers and the spread of contamination. Radioactive material that has been surveyed for release should be properly tagged or labeled. Personnel who need to removal radioactive material from controlled areas should contact radiological protection personnel for release surveys and authorization. DOE/EH-0256T, *U.S. Department of Energy Radiological Control Manual*, provides clear direction on the marking, monitoring, and control of radioactive materials. Chapter 4, part 1, “Radioactive Material Identification, Storage, and Control,” provides guidance for labeling radioactive material.

- Section 411, “Requirements,” states that any equipment or system component removed from a process that may have had contact with radioactive material should be considered contaminated until disassembled to the extent required to perform an adequate survey, surveyed, and shown to be free of contamination.

- Section 412, “Radioactive Material Labeling,“ states that radioactive material outside contamination, high contamination, or airborne radioactivity areas shall be labeled in accordance with Table 4-1 of the Manual.

Equipment, components and other items with actual or potential internal contamination should be labeled "CAUTION, INTERNAL CONTAMINATION" or "CAUTION, POTENTIAL INTERNAL CONTAMINATION." Labels should include contact radiation levels, removable surface contamination levels (specified as alpha or beta-gamma), dates surveyed, surveyor's name, and description of items. Items that are too small to be labeled with all of the stated information should be labeled, at a minimum, with the words "CAUTION RADIOACTIVE MATERIAL" and the standard radiation symbol.

Chapter 4, part 2, “Release and Transportation of Radioactive Material,” provides guidance for releasing radioactive material from controlled and uncontrolled areas and for transporting it off-site.

- Section 422, “Release to Uncontrolled Areas,“ states that material in controlled areas or radioactive material areas, documented to have been released from contamination, high contamination, or airborne radioactivity areas, shall be surveyed before release to uncontrolled areas.

- Section 423, “Transportation of Radioactive Material,” states that off-site shipments of radioactive material, including subcontractors' handling of off-site shipments, shall be controlled and conducted in accordance with the Radiological Control Manual and applicable Federal, state and local regulations.

KEYWORDS: radiation protection, labeling, pump, radioactive material, shipping, tritium

FUNCTIONAL AREAS: Radiation Protection

4. SPENT FUEL CANISTER DROPS WHEN HANDLING FIXTURE DISENGAGES

On October 17, 1997, at the Oak Ridge National Laboratory, a small canister of spent fuel material fell approximately 20 feet to the floor of a hot cell when the canister disengaged from its handling fixture. Fuel handlers were transferring the canister from a bottom-loading cask to a top-loading, DOT-approved shipping cask for shipment to the Savannah River Site. The canister was not significantly damaged, and there was no damage to the hot cell. Radiological control personnel took smear surveys of the canister and detected no release of the canister contents (various fissile material). Nuclear Criticality Section personnel verified that no criticality issues existed. Fuel handlers placed the canister in the shipping cask basket assembly for storage to await disposition. Investigators believe the lack of a positive latch mechanism on the handling tool contributed to the incident. Inadvertent disengagement of spent fuel elements, assemblies, or storage canisters could result in damage to the fuel cladding. Although no fission gases were present in the canister because of the age of the material, a breach in fuel cladding could release fission gases that could expose personnel to airborne contamination. (ORPS Report ORO--ORNL-X10CHEMTEC-1997-0014)

The spent fuel was double-encapsulated in the aluminum canister. At the time of the disengagement, fuel handlers were attempting to lower the canister out through the bottom of the cask using the handling tool. The canister is attached to the tool, and the tool is locked to a flange that attaches to the top of the cask. Fuel handlers attach a wire rope to the threaded end of the handling tool, release the locking pin that secures the tool to the flange, and lower the canister out of the cask. During this evolution the wire rope went slack, indicating that the canister may have hung up. When the handlers attempted to re-close the opening in the bottom of the cask, the canister fell out to the hot-cell floor below.

Figure 4-1 shows the handling tool attached to the bail on the top of the canister. The canister bail slides into a slot in the tool, and the tool is rotated 90 degrees. The bail sits in a recess in the handling tool and is held in place by the weight of the canister. The tool is housed inside a sleeve and attached to the flange by a locking pin. The flange mates with the top of the bottom-loading cask. A planned corrective action is to replace the handling tool with one that is hollow with a rod inside that will block (close off) the opening once the tool is engaged. This will provide positive locking that will require deliberate action on the part of the fuel handlers to disengage the canister.

Enlargement of bail area

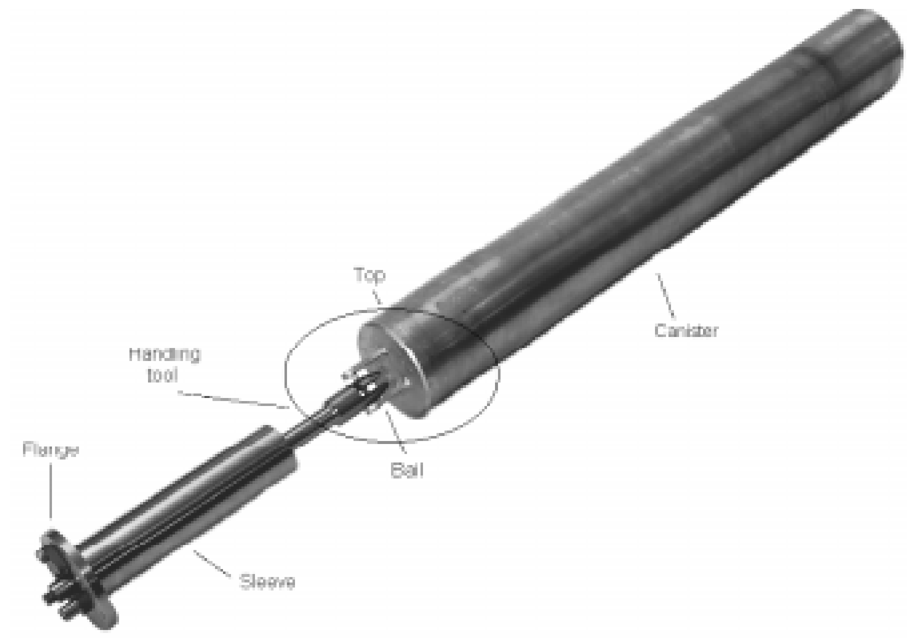


Figure 4-1. Handling Tool and Canister

OEAF engineers reviewed the following dropped-fuel events that resulted because handling tools did not have a positive locking mechanism.

- On September 18, 1997, at the Oak Ridge National Laboratory, a shim-element fell from a handling tool during an underwater inspection. The element fell approximately 40 inches to the pool floor. The handling tool used an adjustable vice grip clamp to grasp the fuel element. Investigators determined the root cause of the incident was inadequate design in that the tool did not assure positive locking. The handling tool will be re-designed for positive locking, qualified, and tested. (ORPS Report ORO—LMES-X10ENVRES-1997-0008)

- Weekly Summary 97-18 reported that a fuel-handling tool accidentally released an irradiated fuel element while an operator was inserting it into a spent fuel grid at the Idaho National Engineering Laboratory Advanced Test Reactor. The element came to rest in a horizontal position on top of the grid in the fuel transfer canal. Investigators determined that the canal fuel-handling tool did not have a positive locking device. In July 1991, the management and operating contractor implemented a requirement for a tool with a positive locking device after a fuel element dropped in the canal. However, investigators believe the requirement was not retained during the transition to a new management and operating contractor. (ORPS Report ID--LITC-ATR-1997-0009)

These events underscore the importance of ensuring that handling tools are designed to prevent inadvertent disengagement of the load, whether the load is nuclear fuel, radioactive sources, casks, or canisters. Disengagement should require a deliberate action by the operator or handler. Operators should understand how these tools and locking devices function. They should also verify that the devices are in proper working condition. Periodic maintenance is also important because positive locking devices may incorporate more moving parts that could require adjustment and could be affected by wear or corrosion. A recent event occurred at the

Savannah River Receiving Basin for Off-site Fuels, when a cask fuel basket containing seven fuel assemblies disengaged from a positive-locking grappler tool and fell approximately 15 feet to the basin floor. Investigators believe the grappler fingers may not have been completely engaged. They incorporated procedure steps to verify that screws on the grappler mechanism are properly torqued, to check the spread of the fingers to ensure complete closure, and to verify engagement using underwater cameras. (ORPS Report SR--WSRC-RBOF-1997-0010)

KEYWORDS: fuel assembly, operations, transfer, design

FUNCTIONAL AREAS: Operations, Design

OEAF FOLLOWUP ACTIVITY

1. CORRECTION TO WEEKLY SUMMARY 97-42, ARTICLE 1, DRUMS OF CONTAMINATED MATERIAL FALL FROM TRUCK

The article incorrectly cited DOE O 1540.1A, *Materials Transportation and Traffic Management*. This Order was replaced by DOE O 460.2, *Department Materials Transportation and Packaging Management*. Guidance for loading methods and tie-down can be found in Chapter 3 of the draft implementation guide, DOE G 460.2A-1.

KEYWORDS: drum, mixed waste, spill, waste handling, forklift, dropped load

FUNCTIONAL AREAS: Materials Handling/Storage